AECOM

Randy Sillan, PhD, PE, BCEE
Principal Environmental Engineer
NAPL Technical Practice Group Leader

Areas of Expertise

NAPL Strategies

- Petroleum LNAPL
- Chlorinated Solvent DNAPL
- Coal Tar and Creosote
- NAPL Conceptual Site Model
- Risk-Based Management
- Remediation Strategies
- Mobility and Recoverability
- Natural Source Zone Depletion
- Innovative Technologies

Remediation

- In Situ Technologies
- Surfactant and Cosolvent Strategies
- Organic and Inorganic Contaminants
- Remedial Alternatives Evaluations
- Feasibility Studies/Pilot Studies
- Remedial Action Plans and Designs
- Project Reviews
- Modeling for Remedial Design

Site Investigation

- Rapid Characterization Tools
- Mass Flux Assessment
- Conceptual Site Models
- Tracer Techniques

Education

PhD / Hydrologic Sciences, Soil and Water Science / University of Florida / 1999

ME / Environmental Engineering / University of Florida / 1995

BSME / Mechanical Engineering / University of Florida / 1991

Years of Experience

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Summary

Dr. Sillan has over 18 years of experience as an environmental consultant and remediation engineer with extensive experience coordinating and developing expertise in NAPL investigation and remediation strategies. He is a nationally recognized expert on NAPL characterization, management, and remediation; leads AECOM's NAPL Technical Practice Group; and has co-instructed NGWA's NAPL Short Course. Dr. Sillan is the Chair of the national committee that develops the professional environmental engineering exam and is a Board Certified Environmental Engineer by the American Academy of Environmental Engineers and Scientists.

While serving as a technical lead on projects, Dr. Sillan evaluates, develops, designs, and implements remedial strategies for sites contaminated with fuel hydrocarbons, oils, chlorinated solvents, tars, creosote, and metals. He develops remedial alternative evaluations, treatability studies, and remedial action plans for various types of sites, including industrial manufacturing, petroleum refining and retail, manufactured gas plants, dry cleaners, agriculture, and utilities.

While researching and developing innovative remediation technologies, Dr. Sillan has published peer-reviewed articles and presents at conferences. He has conducted several field-scale demonstrations of in situ NAPL remediation technologies, such as cosolvent flushing, surfactant flushing, and enhanced bioremediation with multiple substrates and delivery methods. Dr. Sillan has extensive experience with advanced NAPL assessment tools, and managed the first field-scale demonstration of the partitioning tracer test to characterize the mass and distribution of NAPL. In support of assessment activity and remedial design, he develops conceptual site models and uses software tools to model fate and transport of contaminants.

Experience

Technical Lead, Libby Creosote Site, Libby, Montana. Technical lead for development of a Feasibility Study for this CERCLA site with an offsite pentachlorophenol groundwater plume from a creosote NAPL source. Project support included development of presentations to USEPA on the CSM, screening of remediation technologies, and development of remedial alternatives. Dr. Sillan also provided technical review and support of pilot studies including development of work plans and reports.

Technical Quality Lead, United Technologies Remediation Program, Multiple Locations in US. Supports technical review and development of site strategies for sites in UTC's portfolio. Dr. Sillan's support ranges from technical review of documents to serving as the technical expert supporting development of site investigation and remediation strategies. Types of sites range from chlorinated solvents in a marine environment to LNAPL petroleum. He has also led development and presentation of CSMs and site strategies to the client and regulatory agencies.

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Technical Expert, USACE Eklutna FUDS Site, Eklutna, Alaska. Supports the project team as an expert for chlorinated solvent investigation and remediation. Dr. Sillan supports preparation of work plans, interpretation of data, and report preparation for a remedial investigation (RI). He leads data review and planning meetings with the Alaska Department of Environmental Conservation and the client, the USACE.

Technical Expert, Canadian National's North Kegley Derailment Site, Thompsonville, IL. Supports the project team as an expert for chlorinated solvent investigation and remediation. Dr. Sillan supported preparation of work plans, interpretation of data, and report preparation for a MiHpt investigation at this PCE tanker car derailment site.

Technical Support, Multiple DOW Sites, Eastern US. Supported development of CSMs and the design and implementation of passive flux meter studies to evaluate contaminant discharge from groundwater to surface water. Based on site reviews and flux studies, Dr. Sillan supported design of investigations to support development of long-term remediation strategies.

Technical Quality Lead, BNSF Remediation Program, Multiple Locations in US. Supports review and development of site strategies for complex LNAPL and DNAPL sites in the BNSF portfolio. Dr. Sillan's support ranges from technical review of documents to serving as the technical expert supporting development of site management strategies including development of feasibility studies and meetings with the USEPA.

Project Manager and Technical Lead, Former Daytona Beach MGP Site, Daytona Beach, Florida. Performed a remedial alternatives evaluation that included assessment of DNAPL mobility and recoverability, dissolved plume stability, and natural source zone depletion. The DNAPL mobility and recoverability assessment included collection of soil and fluid samples that were tested for properties that control multiphase flow of NAPL and groundwater. The analysis indicated that the DNAPL was not mobile and minimally recoverable. Natural processes at the site were also depleting the DNAPL mass at a greater rate than it could be hydraulically recovered. Dr. Sillan designed and implemented a pilot study to evaluate biosparging (aerobic bio-oxidation) to achieve groundwater remedial goals and weather the NAPL as part of the site's risk-based management strategy.

Technical Support, Multiple BP Refinery Sites, Illinois and Kansas. Provided technical development and review of CSMs and supported development of site management and remediation strategies that included feasibility studies.

Technical Lead/Site Review Lead, Strategy Review of Gasoline Retail Sites, Pennsylvania, California, and New Jersey. Led technical and regulatory review of site histories, conceptual site models, and existing site strategies at three sites to develop remedial alternatives and costs. Dr. Sillan also participated in the review of strategies developed for 10 sites that were presented to environmental management at the global oil and gas company, ExxonMobil. The reviews provided the client costs and strategies to quantify environmental liability and pathways to site closure.

Technical and Implementation Lead, PCE Mass Flux Assessment, Denver, Colorado. Designed and implemented a study to quantify the mass flux and discharge from a PCE source area with suspected DNAPL. The approach used five existing wells that formed a transect perpendicular to groundwater flow immediately downgradient of the source area. The

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study objective was to refine the conceptual site model and support evaluation and design of remedial alternatives. Modeling of PCE dissolution from DNAPL and back diffusion from a fractured rock were included in the data analysis.

Project Manager and Technical Lead, Former Palatka MGP Site, Palatka, Florida. Prepared a remedial alternatives evaluation, implemented a field-scale pilot study, and prepared and implemented a remedial action plan. The in situ bioremediation strategy used bioaugmentation, biostimulation, and groundwater recirculation that included a series of injection and extraction wells to deliver bioremediation substrates including microbes, electron acceptors, and surfactants. Dr. Sillan presented this strategy in a Battelle platform presentation. As a polishing step to achieve site closure, an engineered anaerobic bio-oxidation strategy was also implemented using sulfate as the electron acceptor, and was also presented in a Battelle platform presentation.

Technical Lead, Kinder Morgan Las Vegas Terminal, Las Vegas, Nevada. Technical lead for remedial strategies at a fuel terminal with a large LNAPL source area and very long (6,000 ft) MTBE dissolved plume. Dr. Sillan helped develop the remedial strategy presented in an approved CAP with the Nevada Division of Environmental Protection that includes groundwater recirculation to hydraulically control the LNAPL source area and stop mass flux of dissolved contaminants offsite. Dr. Sillan also supported an attenuation evaluation of the offsite plume using spatial moment analysis, development of a contingency plan for offsite plume management and remediation, pilot testing of groundwater treatment alternatives, and full-scale design of the groundwater treatment system that includes fluidized bed reactors.

Technical Expert, Surfactant Flushing Evaluation/Design, Melville, New York. Led the technical evaluation that evaluated the feasibility of cosolvent and surfactant flushing to remediate a cutting/honing oil LNAPL that contained approximately15% PCE. The evaluation included hydraulic modeling, a bench study to identify the optimal surfactant chemistry, and cost analysis.

Technical Expert, Litigation Support for Environmental Claim, Miami Marlins Baseball Stadium, Miami, Florida. Evaluated an environmental cleanup claim and provided professional opinions during construction of the baseball stadium and field for client, Chartis/AIG Insurance, and their counsel. Dr. Sillan's support included a review of arsenic fate and transport at the site, direction of additional assessment activities, review of dewatering operations during construction, cost reviews and evaluations, and preparation of counsel and client positions.

Project Manager and Technical Lead, Drycleaning Solvent Cleanup Program, Florida. Managed or facilitated the assessment, remedial alternatives evaluation, remedial design, and remedy implementation at more than 15 PCE-affected sites in the Florida Department of Environmental Protection (FDEP) Hazardous Waste Site Cleanup and Drycleaning Solvent Cleanup Program. In addition to PCE and daughter products in soil and groundwater, many sites in the program contain PCE as a DNAPL. Remedial approaches and technologies designed and implemented include multi-phase extraction, enhanced bioremediation with multiple substrates, soil vapor extraction, in situ oxidation, and in situ cosolvent flushing.

Project Manager and Technical Lead, Analysis of Environmental Fate and Transport of Therminol VP-1, Termosol 1 and 2, Madrigalejo,

Spain. Performed analyses to evaluate the environmental fate and transport of Therminol VP-1, a DNAPL at ambient conditions. For specific release scenarios, Dr. Sillan modeled the migration of the DNAPL on the ground surface and in the subsurface soil, the migration of dissolved constituents in groundwater, and the transport of aerosols and the volatilized fraction in the atmosphere. Design recommendations and guidelines were provided for managing and responding to releases.

Technical Expert, Former Orlando MGP Site Tracer Study, Orlando, Florida. Helped develop, implement, and interpret an innovative tracer study that included conservative and NAPL-partitioning tracers applied in a push-pull scenario to assess the presence of NAPL and sorbed contaminant mass near selected monitoring wells screened more than 200 feet below land surface in a limestone aquifer. The work included tracer data evaluation using analytical and numerical transport modeling.

Design Lead, Chlorinated Solvent Plume Remediation, Phoenix, Arizona. Dr. Sillan led the development of the design and strategy for a large PCE plume managed by the Arizona Department of Environmental Quality. A focused feasibility study was completed that evaluated multiple remedial alternatives and selected enhanced reductive dechlorination (ERD) for treatability testing. The treatability study included two rounds of molasses solution injection to provide an electron donor and promote ERD. The treatability study also included injection capacity testing to identify safe injection pressures and sustainable injection rates.

Project Manager and Technical Lead, Arsenic Assessment and Remediation at a Former Plant Nursery, Delray Beach, Florida. Prepared and implemented a remedial action plan to obtain regulatory closure. The property was redeveloped as a residential community. As part of the remedial effort, a 10-million-gallon-per-year groundwater treatment system was designed and implemented. To prepare the groundwater remedial design, a groundwater model was developed, calibrated with field data, and used to design the groundwater capture system. The treatment system included a new adsorption media designed to preferentially remove arsenic from groundwater with minimal O&M.

Technical Advisor, Metal Treatment Facilities, Southern California. Conducted in-depth technical reviews of several sites in southern California for Bodycote where former metal treatment facilities released various chlorinated solvents to the subsurface. Dr. Sillan's role primarily consisted of reviewing conceptual site models and remediation history to provide recommendations for strategies to achieve site closure. Strategies included additional assessment to evaluate impact from offsite sources, optimization of existing SVE systems, and assessment of mass flux to quantify risks.

Technical Expert, Surfactant Enhanced Recovery of LNAPL, Sites throughout the U.S. Served as a technical expert on the procedure to enhance recovery of LNAPL and mitigate occurrence of free product using surfactants and a single-well push-pull strategy. Dr. Sillan evaluated the applicability and feasibility of this strategy at numerous retail petroleum sites and helped develop a standard operating procedure for implementation. He also presented a summary of the technical strategy and a review of success in a platform presentation at a Battelle conference.

Project Manager and Technical Lead, Risk Analysis and Response Guidelines for Release of DOWTHERM A, Martin Solar Energy Center, Indiantown, Florida. Performed analyses to evaluate the environmental

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fate and transport of a heat transfer fluid (DOWTHERM A), which behaves as a DNAPL upon release. Using specific release scenarios, multiple modeling tools were employed to understand the migration of the DNAPL on the ground surface and in the subsurface soil and the migration of dissolved constituents in groundwater. The fate and transport analyses were used to prepare recommendations for responding to releases. A review of applicable regulatory requirements was included.

Project Manager and Technical Lead, Former Sages Dry Cleaners Cosolvent Flushing, Jacksonville, Florida. Designed and managed pilot-scale and full-scale in situ cosolvent flushing at a former dry-cleaning facility. The pilot study was completed in 1998 and resulted in recovering 65% of the DNAPL in a three-day period. This work also included implementation of innovative assessment techniques, including high-frequency sub-sampling and multiple partitioning tracer tests, to evaluate the distribution and quantity of DNAPL. Following the pilot study, the first full-scale in situ cosolvent flushing project at a DNAPL site was completed in 2004. In addition, a research study was conducted with U.S. EPA to evaluate ethanol-enhanced biodegradation following cosolvent flushing. This work was published in two peer-reviewed journal articles in *Environmental Science & Technology*.

Technical Lead, Apalachee Correctional Institute LNAPL Evaluation, Apalachee, Florida. At this state-owned facility, Dr. Sillan led the development of assessment and risk-based management of LNAPL from former USTs in two large LNAPL areas. The assessment included a rapid, direct-push approach using laser-induced fluorescence to detect and define the extents of petroleum LNAPL at the sites. The results were used to develop a work plan to assess LNAPL mobility and recoverability and natural source zone depletion.

Technical Expert, Surfactant Enhanced Aquifer Remediation, Former Alameda Naval Air Station, Alameda, California. Provided onsite technical support for implementations of a surfactant flushing treatability study for a TCE DNAPL. Services included construction and operation of fluid handling and treatment systems, which included macro porous polymer extraction (MPPE) and ultrafiltration to recycle surfactants. Dr. Sillan also supported implementation and interpretation of partitioning tracer tests to characterize the quantity and distribution of DNAPL.

Design Engineer and Technical Lead, Chlorinated Solvent Bioremediation, Ballinasloe, Ireland. Prepared and implemented a pilot study to evaluate the efficacy of various substrates, including HRC and ethanol, to enhance bioremediation of a chlorinated solvent at a former manufacturing facility of Cross pens. Based on the results of the pilot study, a full-scale remedial design using ethanol was implemented. The site was the first chlorinated solvent site in Ireland that was closed using bioremediation. Work resulted in publication of an invited paper in 2008.

Project Manager and Technical Lead, Remediation of a Former Coatings Manufacturer, Lenoir, North Carolina. Managed and completed the remediation of a former furniture coatings manufacturing site with a combination of technologies including air sparging, soil vapor extraction, enhanced bioremediation, groundwater containment and recovery, and an aboveground water treatment system. The site was grossly contaminated with more than 20 contaminants of concern prior to remediation in 1997. Active remediation was completed in 2009.

Graduate Research Assistant, Surfactant Enhanced Aquifer Remediation, Hill Air Force Base, Utah. Supported design and

implementation of a field-scale study using a surfactant and alcohol to create a single-phase microemulsion to extract a complex LNAPL with petroleum and chlorinated solvents constituents.

Graduate Research Assistant, Field-Scale Evaluation of In-Situ Cosolvent Flushing and the Partitioning Tracer Test, Hill Air Force Base, Utah. Managed the first field-scale application of in-situ cosolvent flushing and the partitioning tracer test in a NAPL-contaminated aquifer. This study was completed in 1995 and was the first of nine alternative NAPL remediation technologies tested side-by-side at Hill AFB in Utah by SERDP. A cosolvent solution consisting of ethanol, water, and pentanol was used to solubilize and remove a mixed-NAPL comprised of JP-4 and chlorinated solvents. The cosolvent flushing field study was published in two peer-reviewed journal articles in *Water Resources Research*.